

## Poster #176

### Quantifying Stream-Aquifer-Land Interactions Along the Columbia River Corridor Using Integrated Modeling and Observations

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In this element, stream-aquifer interactions in terms of variations in mass exchange rates and groundwater elevations induced by pressure gradient and mass exchange along the Hanford reach of the Columbia River Corridor, as well as their relations to the partitioning of the surface energy budget were quantified, by developing and applying an integrated surface and subsurface model, and analyzing observations from two eddy-covariance tower sites. The integrated model features the coupling of the Community Land Model version 4.5 (CLM4.5) and a massively-parallel multi-physics reactive transport model (PFLOTRAN). The coupled model, named PFLOTRAN\_CLM v1.0, was applied to a 400 m×400 m study domain along the Columbia River shoreline and validated against observations from groundwater monitoring wells. PFLOTRAN\_CLM v1.0 simulations were performed at three spatial resolutions over a five-year period to evaluate the impact of hydro-climatic conditions and spatial resolution on simulated variables. Our numerical experiments suggested that the land-surface energy partitioning was strongly modulated by groundwater-river water exchanges in the periodically inundated fraction of the riparian zone, and enhancing moisture availability in the vadose zone via capillary rise in response to the river stage change. Furthermore, spatial resolution was found to impact significantly the accuracy of estimated the mass exchange rates at the boundaries of the aquifer, and it becomes critical when surface and subsurface become more tightly coupled with groundwater table within six to seven meters below the surface. The findings from model simulations were confirmed by observations from two eddy covariance flux towers. Preliminary analyses of tower measurements suggested that land surface energy fluxes and net ecosystem exchange could vary significantly as a function of accessibility to groundwater and its connectivity to river water. The coupled model developed in this study can be used for improving mechanistic understanding of ecosystem functioning, biogeochemical cycling, and land-atmosphere interactions along river corridors under historical and future hydro-climatic changes, including river reaches downstream to hydropower dams characterized by highly variable river stage variations. The dataset presented in this study can also serve as a good benchmarking case for testing other integrated models.